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PRINCIPAL INVESTIGATOR: Gail H. Cassell, Ph.D.

CONTRACTING ORGANIZATION: The University of Alabama at Birmingham
Birmingham, Alabama 35294-0111

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E-MAIL:
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13. ABSTRACT ***(Maximum 200 Words)***

Cervicovaginal ureaplasmal infection alone is not predictive of preterm birth. Only a subpopulation of women infected in the lower genital tract are at risk for chorioamnion invasion and premature birth. The major goal of the proposed study is to identify microbiologic factors that predispose to and/or predict chorioamnion invasion and premature birth. This study will determine if the presence of bacterial vaginosis (BV) is a risk factor for ureaplasmal invasion of the chorioamnion. 4,312 women have been enrolled to date. Vaginal cultures from all of these women have been assessed for *Ureaplasma urealyticum* (UU) colonization and a subset of gram stains have been assessed for BV. Prenatal screens yield 2,497/4,193 or 60% culturally positive for UU and 486/2,700 or 18% of the gram stains are positive for BV. At delivery, (705 women meeting study criteria for placental cultures including multiple births), the isolation rate of UU from the vagina is 61% regardless of delivery route. The isolation rate of UU from placental tissues is 14%. The rate of BV at delivery is approximately 18%. The correlation of this data may help us better understand adverse pregnancy outcome including preterm birth as it relates to infection of the chorioamnion.

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N/A In the conduct of research involving hazardous organisms, the investigator(s) adhered to the CDC-NIH Guide for Biosafety in Microbiological and Biomedical Laboratories.

Phil R. Cassell

PI - Signature Date

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INTRODUCTION:

Women are playing increasing roles in active duty military service and suffering unexplained adverse outcomes of pregnancy. In the Navy, up to 20% of enlisted women become pregnant each year and nearly 15% of these pregnancies suffer adverse effects. The percentage is in excess of that experienced in most other U.S. female populations and despite a number of preliminary investigations, the difference does not appear to be related to environmental exposures.

Some of the traditional factors associated with adverse outcomes of pregnancy such as limited access to prenatal care or poor nutritional status are not operative among naval personnel, nonetheless at least 10% of Navy live births are premature (< 37 weeks gestation) or low birth weight. In addition, previous studies have indicated among pregnant, enlisted women, spontaneous abortions occur in 9.9%, 2.7% of pregnancies are ectopic and 1.5% result in fetal death (0.7% early and 0.8% late). Bacterial infections of the lower genital tract may in part explain poor pregnancy outcome.

Preterm birth complicates 8-10% of all pregnancies in the U. S. and is the leading cause of infant morbidity and mortality in the U.S. We have previously shown that *Ureaplasma urealyticum* (*Uu*) is the single most common microorganism isolated from the chorioamnion of women in spontaneous labor with intact membranes and in whom there are no chances for cervicovaginal contamination of the placenta (i.e. they delivered by cesarean section with intact membranes). Furthermore, ureaplasmal infection of the chorioamnion in the absence of other bacteria was associated with birth < 37 weeks even after multifactorial analysis to adjust for labor and other obstetric and demographic factors that could confound the association. Infection was inversely related to gestational age and birth weight. Other related studies indicate that ureaplasmal infection is a significant cause of respiratory disease, meningitis and death in very low birth weight infants.

The major goal of the proposed study is to define those women who are at risk for adverse pregnancy outcomes and to determine whether chorioamnion infection, in particular infection with *Uu*, is associated with these outcomes, specifically premature birth. This will allow us to identify factors that may predict invasion and premature birth. We will determine if the presence of BV is a risk factor for ureaplasmal invasion of the chorioamnion. Potential confounders of these data will be controlled through multivariate analyses. They include the presence of other sexually transmitted pathogens, in particular *Chlamydia trachomatis, Neisseria gonorrhoeae*, Group B streptococci, *Trichomonas vaginalis, Mycoplasma hominis*, and *Mycoplasma genitalium.*

BODY:

Experimental methods to be used in this study are identical to those detailed in the original proposal. Since our report last year, we have enrolled an additional 848 patients for a total of 4,312. Our enrollment rate remained about the same as it had been in previous years (61%). Enrollment ended on April 30, 1999. The study population consists of all consenting women presenting at the Naval Medical Center San Diego (NMCSD) for their prenatal visit. These women were screened for BV and *U. urealyticum* at this visit. Women completing the study with cultures at delivery belonged to one of the following categories: all women delivering by cesarean

section with either intact or ruptured membranes, 100 randomly selected vaginal deliveries and all women delivering preterm < 37 weeks gestational age. A flowchart describing the study population is found in Figure 1, Appendix I.

Demographics of the enrollees (those attending NMCSD Obstetrics clinic for their first pre-natal visit) and consenting to participate in the UAB Study are demonstrated below:

Age Range	14-46		
		N	(%)
Race			
	White	2337	(54.5)
	Asian/PI	562	(13.1)
	Black	578	(13.5)
	Spanish/Hispanic	575	(13.4)
	Other	162	(3.8)
	Eskimo/Aleut./American Indian	43	(1.0)
	Multiple race	28	(0.7)
Military Status			
	Navy	782	(19.9)
	Retired Military	29	(0.7)
	Marine	64	(1.6)
	Reserve	36	(0.9)
	Army	6	(0.2)
	Public Health	1	(0.1)
	National Guard	3	(0.1)
	Civilian	3006	(76.5)

Of the 4,312 women that have enrolled in the UAB study and whose outcome data have been analyzed, 2,700 have slides that were analyzed for BV by the Nugent Gram Stain method. Our BV rate of positivity (a score of ≥ 7) continues to be 18%. Trichomonas has been isolated from 36 patients (0.8%). These continue to be consistent with previous year's reports. *U. urealyticum* (*Uu*) has been isolated from 2,497/4,193 (60%) and Mycoplasma species (Myco sp.) has been isolated from 437/4,193 (10%). Speciation of the mycoplasma isolates is yet to be performed. Most of these isolates will probably speciate as *M. hominis*. Any organism that is negative for *M. hominis* will be tested further for its identification.

This study has afforded us the opportunity to follow a large cohort of women as to their delivery outcome. In addition to the women that meet our study criteria and have their placentas, etc. submitted for culture workup, we have collected outcome data on the delivery status of all women that have enrolled in the UAB study at their prenatal visit. This information has been crucial in determining the overall pregnancy outcomes for this population. The outcomes of those deliveries are summarized in Table 2. Flowcharts describing the types of delivery of this patient population at the NMCSD are found in Figures 2,3, and 4 in Appendix I.

Data as of 5/24/99
This represents 2,780 of the 4,312 enrolled
Others yet to be delivered and/or data analyzed

Table 2
Pregnancy Outcome of Entire Study Population
N=2780

Full Term Deliveries > 37 weeks gestation	2221
Preterm Deliveries 25-36 weeks gestation	225
IUFD	25
SAB	293
Abortion/TAB	16

The total bacterial analysis for cultures performed at delivery is not complete. However, we have analyzed the cultural status (ureaplasma and mycoplasma) of 705 women at delivery. The results are as follows:

Vaginal (n=664)	Negative	255/664 (38%)
Cultured at the time	*Ureaplasma urealyticum*	403/664 (61%)
of delivery	*Mycoplasma species*	36/664 (5%)
	Overgrown with yeast or bacteria	4/664 (0.6%)
Cultures positive for both organisms (*U. urealyticum* and *M. hominis*)		5/664 (0.8%)
Placental tissue (n=705)	Negative	599/705 (85%)
	Ureaplasma urealyticum	100/705 (14%)
	Mycoplasma species	11/705 (1.6%)
Cultures positive for both organisms (*U. urealyticum* and *M. hominis*)		5/705 (0.7%)
Amniotic Fluid (n=133)	Negative	112/133 (84%)
	Ureaplasma urealyticum	21/133 (16%)
	Mycoplasma species	0
Infant Nasal (n=691)	Negative	547/691 (79%)
Cultured at the time	*Ureaplasma urealyticum*	137/691 (20%)
of delivery	*Mycoplasma species*	8/691 (0.7%)
Cultures positive for both organisms (*U. urealyticum* and *M. hominis*)		3/691 (0.4%)

During year 04, we have had two interesting cases to report of women with adverse pregnancy outcomes.

Patient 1

Maternal Age	21 years
Military Status	Dependent Spouse
Delivery route	Vaginal
Complication of pregnancy	PPROM (Preterm premature rupture of membranes)
Gestational age	18 weeks
Infant Outcome	IUFD (Intra-uterine fetal demise)
Placental pathology	Chorioamnionitis and funicitis
Placenta culture results	*Ureaplasma urealyticum, Prevotella bivia*
Autopsy culture results	
Brain tissue	*Ureaplasma urealyticum , Prevotella bivia*
Liver tissue	*Ureaplasma urealyticum , Prevotella bivia, Peptostreptococcus anaerobius*
Lung tissue	*Ureaplasma urealyticum, Gardnerella vaginalis, Escherichia coli*
Cord blood	*Ureaplasma urealyticum, Gardnerella vaginalis, Peptostreptococcus anaerobius, Peptostreptococcus magnus*

Patient 2

Maternal Age	22 years
Military Status	Active duty
Delivery route	Cesarean section with membranes intact
Complication of pregnancy	Decreased fetal movement
Gestational age	33 weeks
Infant Outcome	Mild Respiratory distress syndrome (RDS)
Endotracheal aspirate culture results	*Listeria monocytogenes*
Placental culture results	*Listeria monocytogenes*

Baby admitted to neonatal intensive care unit and intubated for 2 days. Treated with ampicillin. for 10 days then sent home. Mom treated with two doses of ampicillin intrapartum and was discharged post op on day 2.

In May, a poster was presented at the 99th General Meeting of the American Society for Microbiology in Chicago, IL entitled "*Ureaplasma urealyticum* is the Most Common Organism Isolated from Cord Blood". A copy of the poster is included in Appendix II. Data for this presentation was obtained from results from a subgroup of this study population. When the culture of cord blood was added to the study protocol, it became evident that *U. urealyticum* was the most common organism detected by culture. We were very interested in seeing how this correlated with poor infant outcome. Further studies are required.

CONCLUSION:

As you are aware, a no-cost extension was requested and awarded for this study. This was necessary to follow the last enrollees to term and to have adequate time for data analysis. Enrollment ended on April 30, 1999. Since that time, we have been following the deliveries of study participants. The last enrollee's estimated date of delivery is 1/3/2000. Recently, we have begun analyzing demographic data of the NMCSD population ensuring that it is comparable to that of our study population. Data being looked at includes the detection rates of *Neisseria gonorrhoeae* and *Chlamydia trachomatis*, marital status, age, race, and parity. Analysis of the study data will begin in February of 2000 after the final culture results and chart reviews have been completed.

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APPENDIX I

Figure 1

ENTIRE STUDY POPULATION

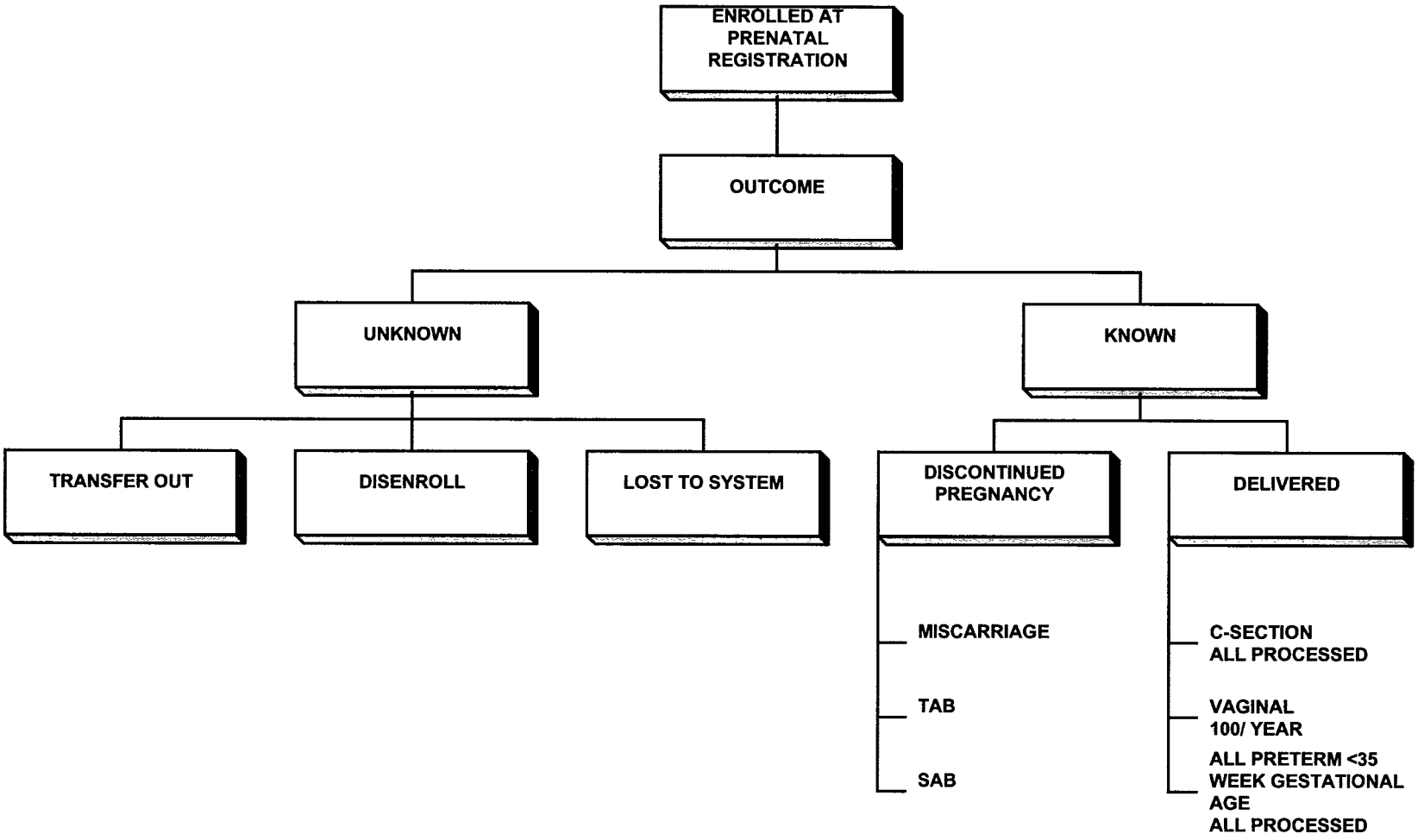
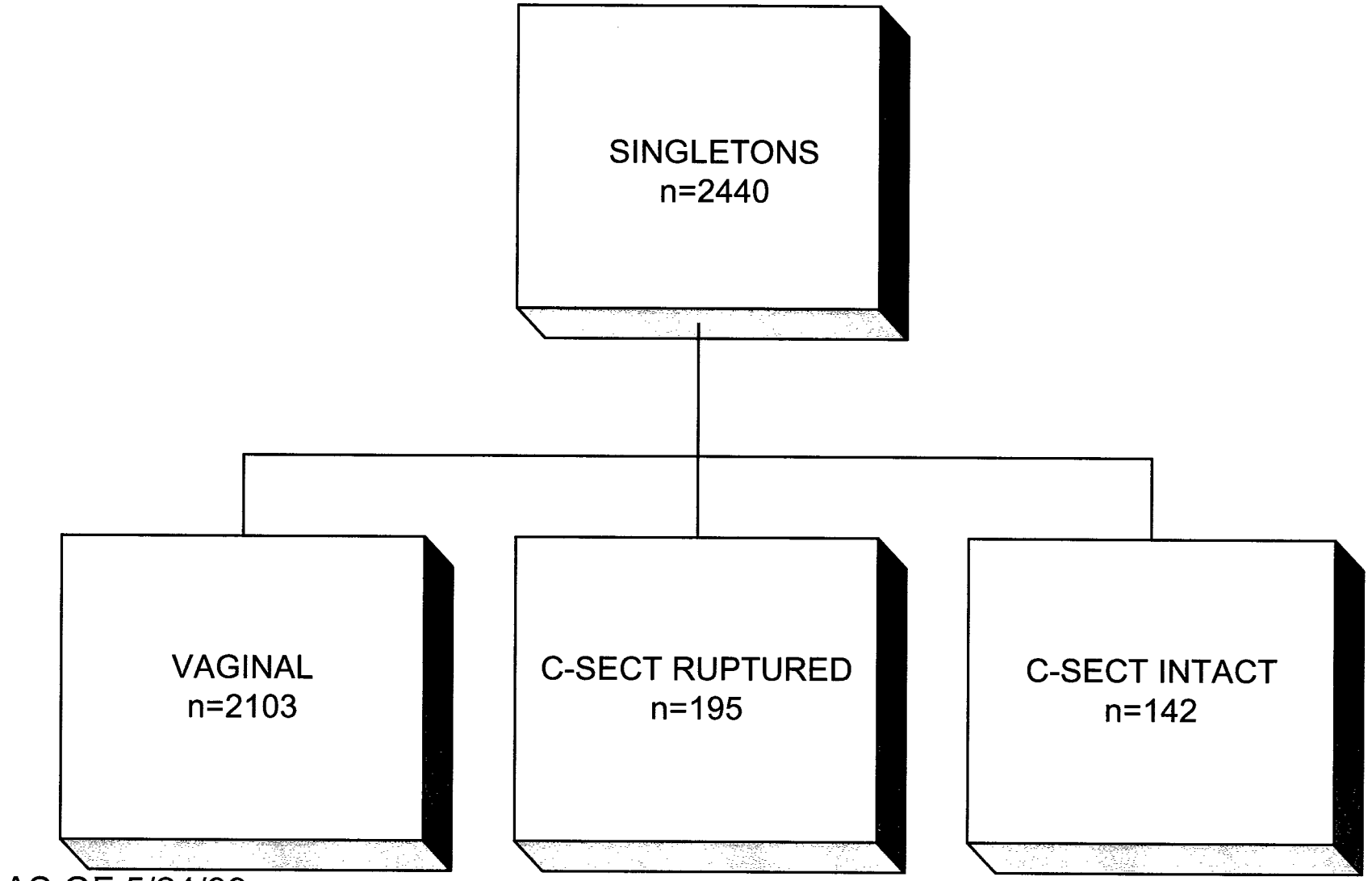


Figure 2

TOTAL DELIVERIES

DELIVERY TYPE BREAKDOWN OF ENTIRE STUDY POPULATION

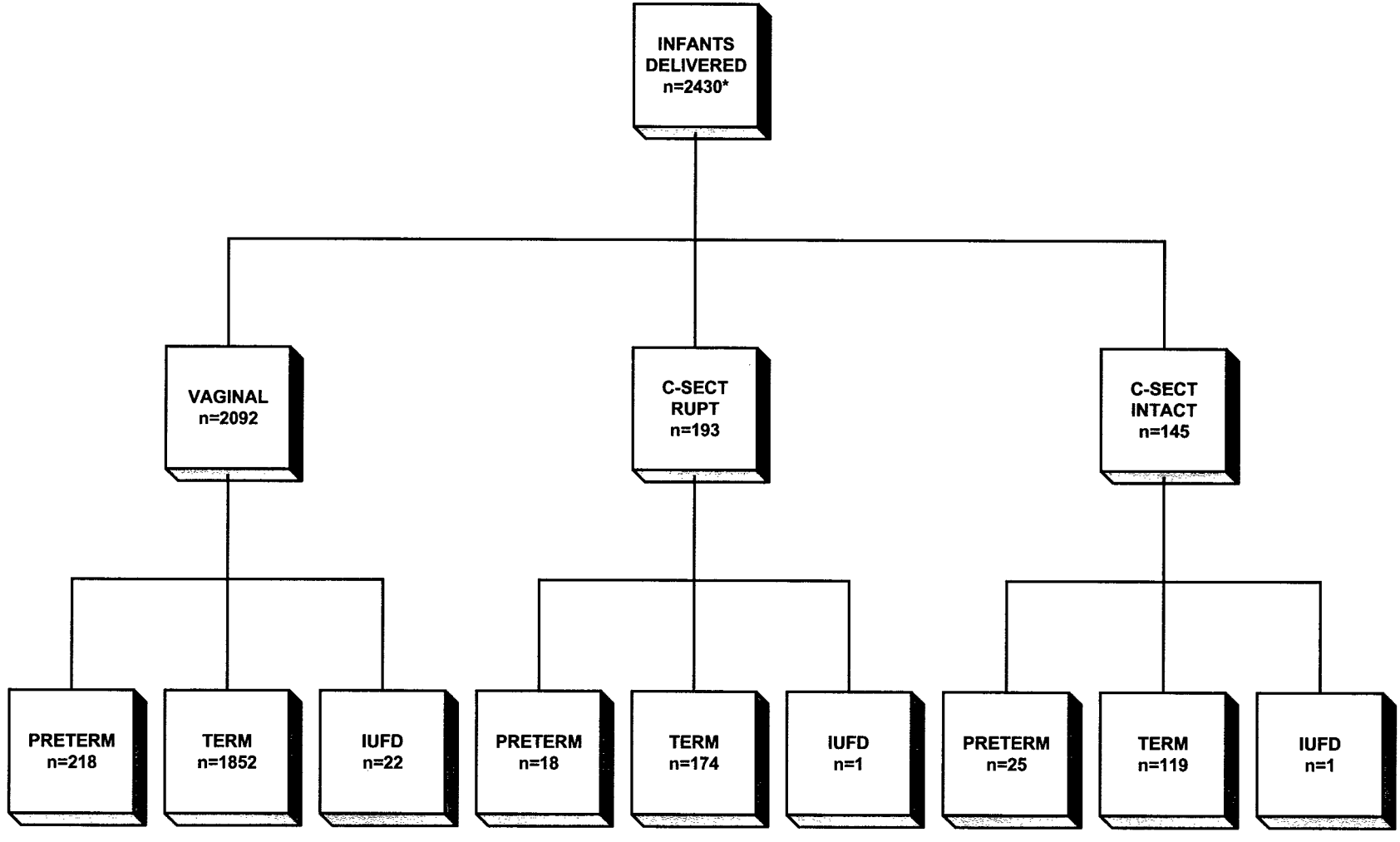


AS OF 5/24/99

Figure 3

TOTAL DELIVERIES

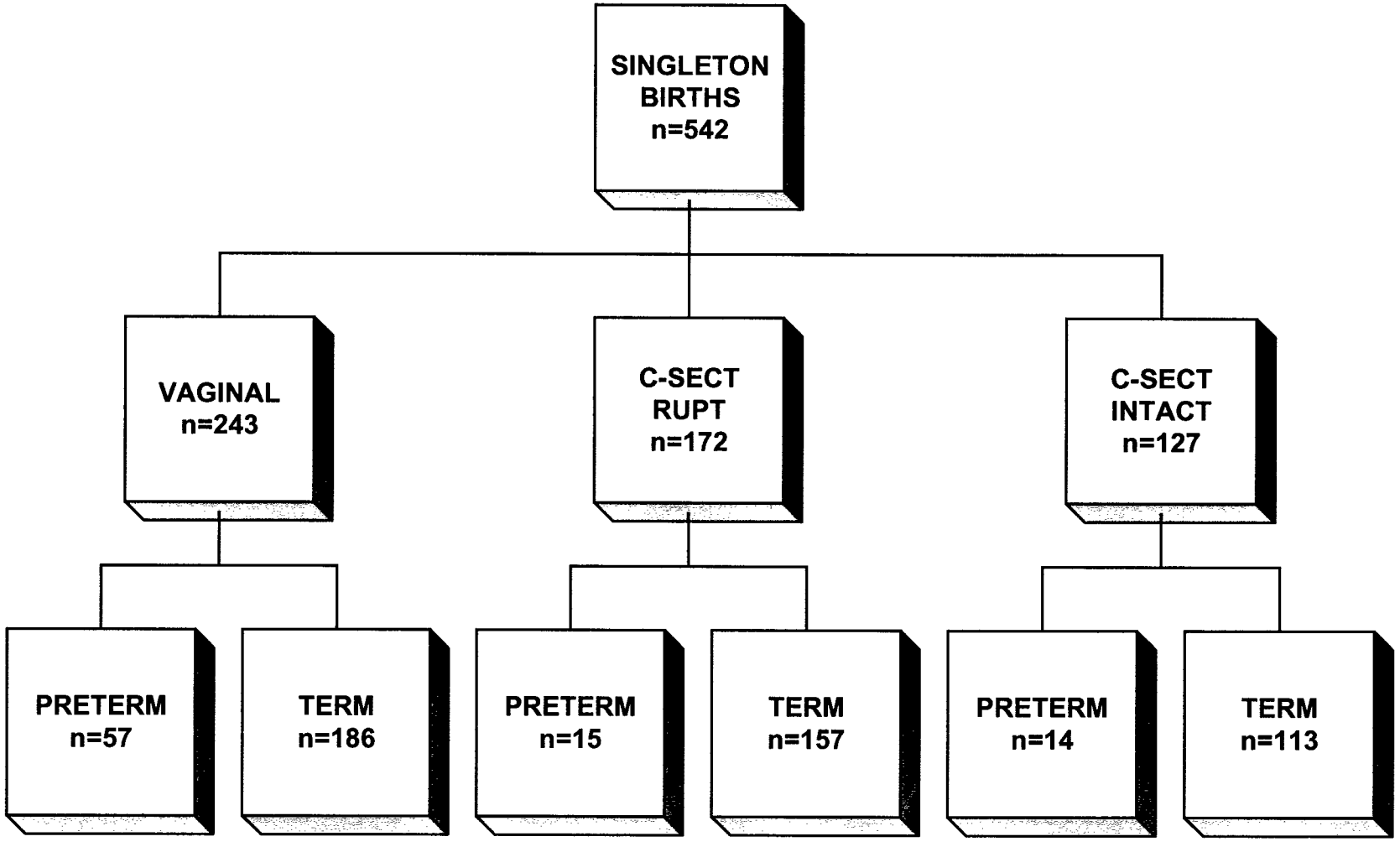
PRETERM BREAKDOWN < 37 WEEKS OF ENTIRE STUDY POPULATION



5/24/99 * 10 gestational ages missing

Figure 4

DELIVERY STATUS OF WOMEN MEETING PLACENTAL CULTURE CRITERIA



AS OF 5/24/99

APPENDIX II

Ureaplasma urealyticum is the Most Common Organism Isolated from Cord Blood

L.B. Duffy[1], P.D. Stamper[2], M.P. Berzins[2], M.J. McCaffrey[2], G.C. Gray[3], and G.H. Cassell[4]

[1]University of Alabama at Birmingham, Birmingham, AL; [2]Naval Medical Center San Diego, San Diego, CA; [3]Naval Health Recearch Center, San Diego, CA; [4]Lilly Research Laboratories, Indianapolis, IN.

ABSTRACT/INTRODUCTION

Ureaplasma urealyticum (*Uu*) is not routinely sought when evaluating neonates for early onset sepsis. *Uu* is a commensal organism of the lower genital tract of females and in a subpopulation of women it can invade the upper genital tract and potentially become a pathogen. In this subpopulation, *Uu* is a significant cause of chorioamnionitis and is associated with preterm birth and neonatal morbidity and mortality. Cord bloods were cultured within an hour of delivery, as part of an ongoing study to evaluate the potential effect of *Uu* chorioamnionitis on adverse pregnancy outcome.

One hundred eighty cord bloods have been analyzed for *Uu* and other bacteria. 76/180 specimens (42%) were positive for one or more microorganisms. *Uu* was isolated from 42/76 (55%), 24 of 42 (57%) were in pure culture. The next most common single organism isolated was E. coli (9/76 or 12%). Mycoplasma species was isolated from only one cord blood and this was cultured in conjunction with *Uu*. The other most commonly isolated microorganisms were as follows *Lactobacillus sp.* (7), *Gardnerella vaginalis* (8), *Propionibacterium sp.* (5), and *Eubacterium lentum* (6). *Uu* is the most frequently isolated microorganism from the cord blood. Increasingly, cord blood is being used for autologous transfusions in premature infants and for unrelated donor hematopoietic stem cell transplantation without

Uu and *Mycoplasma sp.* screening. The neonatal outcomes associated with *Uu* accentuates the need to assess the clinical significance of our findings.

METHODS

The study population included those women presenting for their first prenatal visit at the Naval Medical Center, San Diego, CA and who subsequently met study criteria and were followed at delivery. Study participants included both active duty and dependent pregnant women. This population was chosen because confounding risk factors such as occupational exposures, economic status and access to health care are well controlled for, thus making them an ideal study population. Age of study participants ranged from 14 to 46 years with a mean age of 25.6 years. 84.4% of the women were married. The military status of this population included 19.9% on active duty, 70.5% non-active duty (dependents), and 9.6% reservists. The ethnic background of the study population was 54.5% Caucasian, 14.5% Asian, 13.4% Hispanic, 13.1% African American, and 4.5% other.

Placental Cultures:

Placentas were collected immediately at delivery, placed in sterile plastic zip-lock bags, and were processed within one hour of delivery. Great care was taken to reduce the chance of contamination in the culturing of placental tissues. Processing took place in a biosafety cabinet. Placentas were placed on a sterile surface and using sterile gloves examined for anatomical malformations or lesions suggestive of infection. Using aseptic technique, incisions were made on the fetal surface of the placenta and the amnion was separated from the chorion using sterile surgical instruments. Membrane specimens were obtained by swabbing the interface between the chorion and the amnion. Three sites from the chorioamnion were sampled with priority given to areas where abnormalities were present. The chorioamnion swabs were inoculated into 3.0 ml of sucrose phosphate buffer with 10% fetal calf serum (2SP). Half of the inoculum (1.5ml) was cultured on aerobic media and ureaplasma transport media while the remaining 1.5ml was transported to the anaerobic chamber for further processing.

The placental tissue (at least 3 sites sampled) was collected with sterile forceps and scissors and placed into a sterile petri dish containing 3.0 ml of 2SP for aerobic cultures. Half of the placental tissue sampled was placed into pre-reduced medium for transport to

an anaerobic chamber. Further, the aerobic processing of the placental tissue included the mincing of tissues with sterile scissors and inoculation of this tissue suspension into the appropriate media for culture of aerobic bacteria including transport media for ureaplasma and mycoplasma. The media used for aerobic culture of the chorioamnion interface and placental tissue included Becton Dickinson's Trypticase Soy Agar with 10% Sheep Blood, V Agar, and Chocolate II Agar with Hemoglobin & IsoVitaleX. Also, a Chocolate II Agar with Hemoglobin & IsoVitaleX was inoculated from the chorioamnion inoculum and placental tissue suspension to be incubated in a reduced oxygen atmosphere (10% CO_2, 5% O_2, 85% N_2). Anaerobic cultures were processed in an anaerobic chamber, Bactron II. The placental tissue from the anaerobic transport media was aseptically processed by mincing with sterile instruments in 3 ml of 2SP. The 2SP from the chorioamnion inoculum and the placental tissue suspension were plated to the appropriate medias for culture of anaerobic bacteria. The anaerobic media onto which the specimens were plated was Pre-Reduced Anaerobically Sterilized Bacteroides Bile Esculin Agar, Brucella Blood Agar with Vitamin K & Hemin, Brucella Laked Blood Kanamycin Vancomycin, Phenylethyl Alcohol Blood Agar, and inoculated Thioglycolate Medium with Hemin, Vitamin K & Calcium Carbonate from Anaerobe Systems.

Aerobic cultures were incubated at 36.5°C in 7% CO_2, and checked daily for five days. Anaerobic cultures were incubated at 36.5°C for seven days. The reduced oxygen culture was incubated at 36.5°C. and checked on day three and day seven. At day seven, no growth reduced oxygen cultures and anaerobic cultures were discarded. Negative cultures were blind passed aerobically to Chocolate II Agar with Hemoglobin & IsoVitaleX and anaerobically to CDC Anaerobic Blood Agar from the Thioglycolate Medium on the fifth day to detect any microorganisms which failed to grow on the original plates. All bacteria were isolated and identified using standard biochemical or enzymatic tests.

Mycoplasma cultures were frozen at –70°C and were shipped on dry ice to the Diagnostic Mycoplasma Laboratory monthly. Once the specimens were thawed, serial dilutions were made in 10 B and SP4 broth. 20 µl aliquots of the original specimen and of each aliquot were plated on the appropriate agar (A8 for 10 B and SP4 for SP4). Organisms routinely sought were *U. urealyticum*, *M. hominis*, and *M. genitalium*. Broths were incubated at 37°C in room air (14 days for 10 B and 6 weeks for SP4). Broths were read daily for detection of a color change. Plates were incubated at 37°C in 5% CO_2 (14 days for A8 and 6 weeks for SP4). Plates were read three times each week prior to being reported out as negative. Negative SP4 broth cultures were blind passed (broth to agar inoculation) between days 10 to 21 to increase the chance of isolating *M. genitalium*.

Cord Blood:

Cord blood was collected most often in labor and delivery and was collected from the umbilical vein after the cord had been clamped and cut. The cord blood was drained into a large syringe and placed into a vacutainer tube and sent for culture. The remaining cord blood was submitted for routine blood analysis. In the event the cord blood was not collected at the time of delivery, the cord was disinfected in the biosafety cabinet in the study laboratory by wiping with 70% alcohol. A syringe was used to collect the blood from a vein through the outside wall of the cord. 0.5 ml of cord blood was inoculated into 10B broth (1:6 dilution) for the detection of ureaplasma and mycoplasma. Serial dilutions were made in 10 B broth. 20 µl aliquots of the original specimen and of each aliquot were plated onto A8 agar. The 10 B cultures were monitored daily for a color change and agar plates read daily for colonial confirmation. For the detection of aerobes and anaerobes, O.5 ml of cord blood was also inoculated into Thioglycolate Medium with Hemin, Vitamin K & Calcium Carbonate (1:14 dilution). The Thioglycolate broth was examined daily and negatives were blind passed aerobically and anaerobically on the fifth day. All bacteria isolated were identified by standard biochemical or enzymatic tests.

RESULTS

To date, we have analyzed 180 cord blood specimens for bacterial infection. The most common organisms isolated from those specimens are found in Table 1. 76/180 (42%) were culturally positive for one or more bacterial species. Of those, 42/76 (55%) were positive for *U. urealyticum* (Figure 1). Many of the organisms isolated from these sites could be considered vaginal contaminants. However, finding them in pure culture argues against that fact. *Uu* was detected in pure culture in 24/76 (32%) of all positive cord blood cultures. Other organisms isolated in pure culture from the cord blood were *E. coli* (2), *G. vaginalis* (2), *Lactobacillus* (1), *E. lentum* (1), *Peptostreptococcus sp.* (3), and B*acteroides/ Prevotella sp.* (6) and Propionibacterium sp. (5).

Knowing that bacterial infections have been associated with adverse pregnancy outcomes, we were especially interested in the outcomes of those mothers and infants whose cord blood were culturally positive. Outcomes selected (Table 2) are those generally thought to be associated with bacterial infections. The infants with one or more microorganisms cultured from cord blood are significantly associated with adverse pregnancy outcome ($p=0.038$) when analyzed by chi^2 (95%CI). None of the thirty-six bacterial species identified were associated significantly when compared individually to adverse pregnancy outcomes. However, even considering the small sample size (n=180) and the use of basic analysis without controlling for confounders, there was a positive trend with respect to *Uu* isolation.

When comparing the cultural data from the cord bloods with that of the corresponding placental tissue, *Uu* was again the most common organism isolated from both sites (Table 3). When at least one organism isolated from the cord blood was also isolated from the corresponding placenta and adverse outcomes were assessed, the infants were at increased risk for adverse outcomes ($p=0.022$). (Figure 4).

CONCLUSION

Given the frequency with which *Uu* occurs in cord blood and placental tissue and the potential risks, there is need to assess the clinical significance of our findings. Because cord blood is increasingly being used in premature infants for autologous transfusions and for unrelated donor hematopoietic stem cell transplantation and ureaplasmas and mycoplasmas are not included in the screening process, the need for additional studies is all the more urgent.

Table 1

Most Common Organisms Found in Cord Blood

Organism	Total including Other Bacteria		Alone	
Ureaplasma urealyticum	42/76*	55%	24/76	32%
Escherichia coli	9/76	12%	2/76	2%
Gardnerella vaginalis	8/76	11%	2/76	2%
Lactobacillus	7/76	9%	1/76	1%
Eubacterium lentum	6/76	8%	1/76	1%
Bacteroides/Prevotella species	18/76	24%	6/76	8%
Peptostreptococcus species	6/76	8%	3/76	4%
Propionibacterium species	5/76	7%	5/76	7%

*This number includes those cultures that had Uu alone

Table 2

ADVERSE INFANT OUTCOMES USED IN ANALYSIS

RULE OUT SEPSIS

RESPIRATORY DISTRESS SYNDROME

TEMPORARY TRANSIENT TACHYPNIA

NEONATAL DEATH

PREMATURE PROLONGED RUPTURE OF MEMBRANES

INTRAUTERINE FETAL DEMISE

CHRONIC LUNG DISEASE

INFANT PNEUMONIA

SMALL GESTATIONAL AGE

CLINICAL CHORIOAMNIONITIS

POST PARTUM ENDOMETRITIS

Table 3

Common Cord Blood Isolates Also Found in Placental Tissues

Organism	Number of Cord Positive	Corresponding Placenta Positive
Ureaplasma urealyticum	42	16
Escherichia coli	9	3
Gardnerella vaginalis	8	5
Lactobacillus	7	3
Eubacterium lentum	6	1
Bacteroides/Prevotella species	18	2
Peptostreptococcus species	6	2
Propionibacterium species	5	0

Figure 1

BACTERIAL RESULTS OF 180 CORD BLOODS

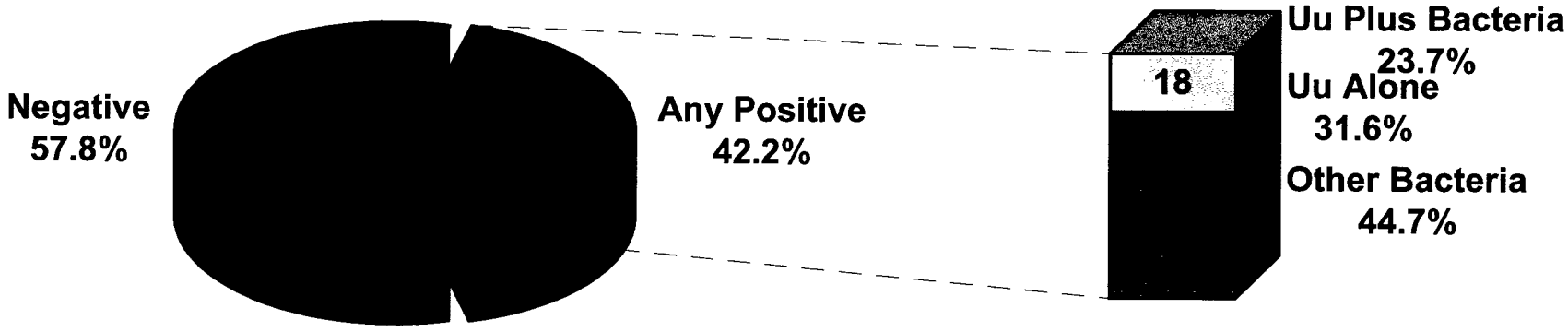


Figure 2

Cord Blood Culture Results in Relation to Adverse Infant Outcomes

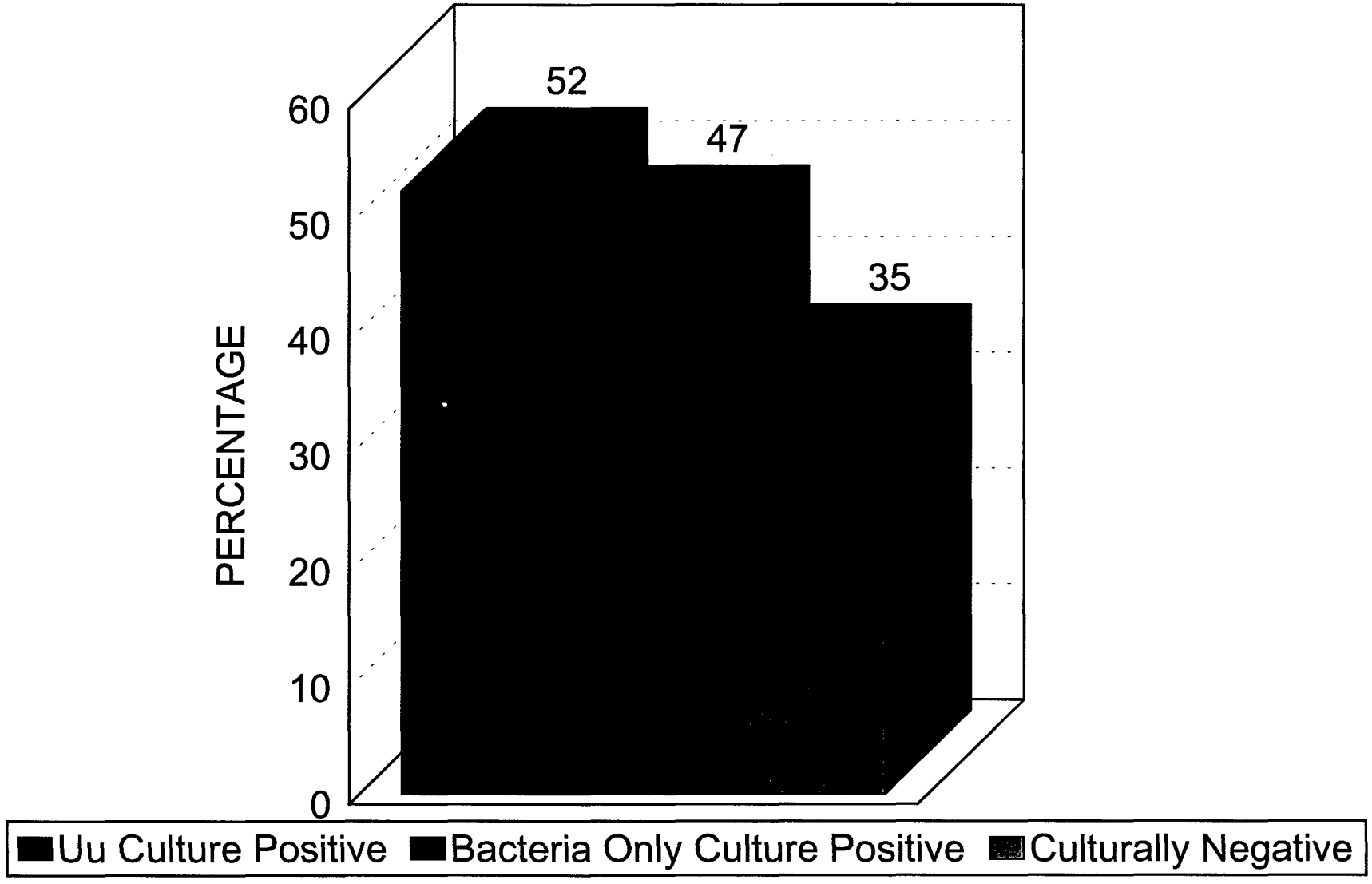


Figure 3

Adverse Infant Outcomes in Relation to Cord Blood Culture Results

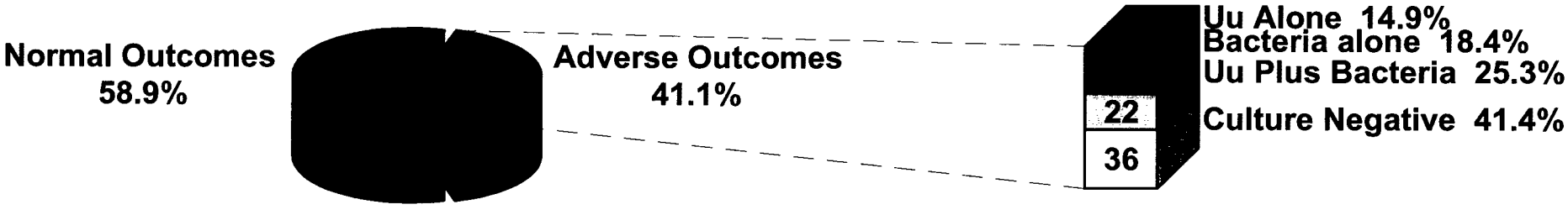
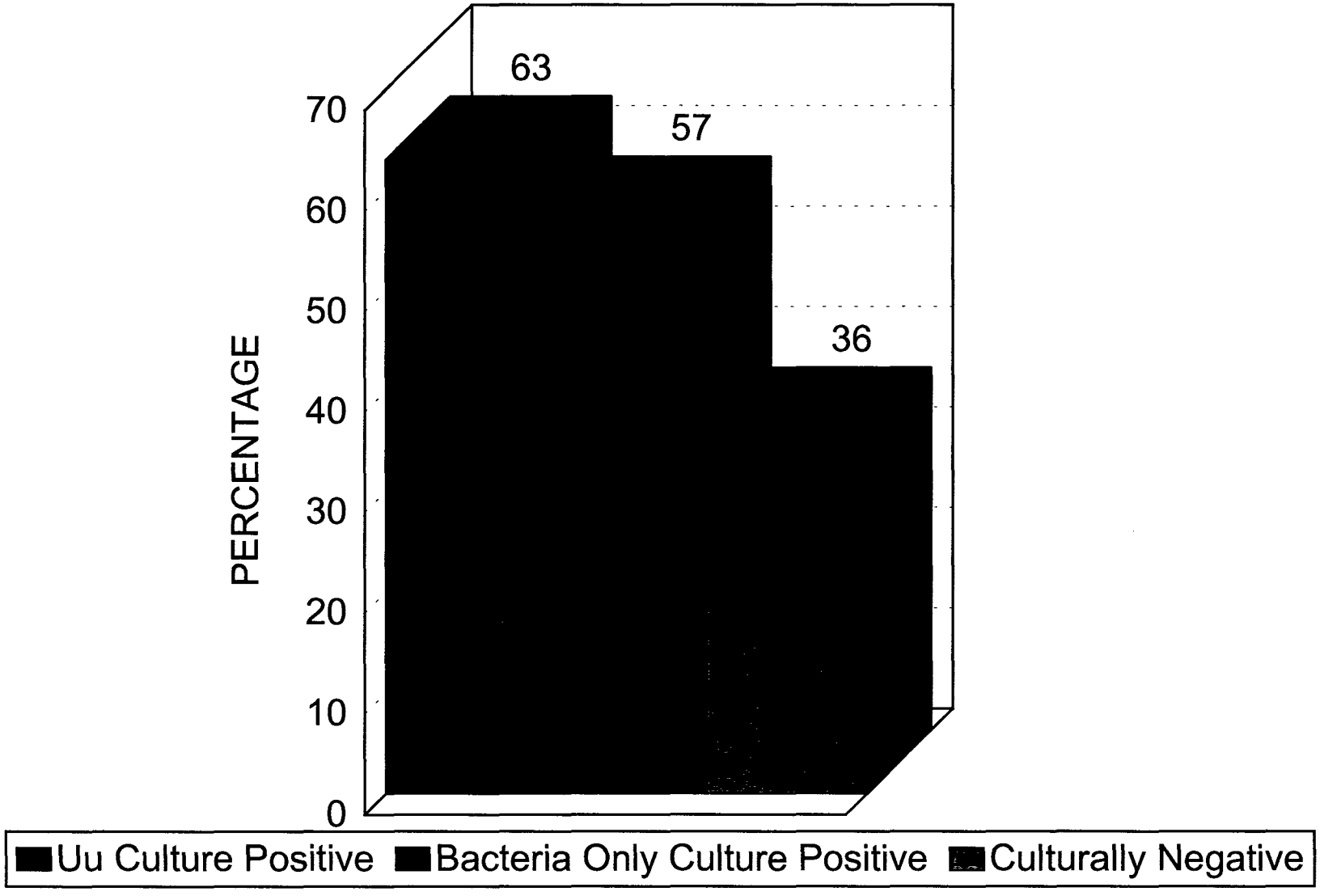


Figure 4

Cord Blood Culture and Corresponding Placenta Culture Results in Relationship to Adverse Infant Outcome



DEPARTMENT OF THE ARMY
US ARMY MEDICAL RESEARCH AND MATERIEL COMMAND
504 SCOTT STREET
FORT DETRICK, MARYLAND 21702-5012

REPLY TO
ATTENTION OF:

MCMR-RMI-S (70-1y) 26 Aug 02

MEMORANDUM FOR Administrator, Defense Technical Information Center (DTIC-OCA), 8725 John J. Kingman Road, Fort Belvoir, VA 22060-6218

SUBJECT: Request Change in Distribution Statement

1. The U.S. Army Medical Research and Materiel Command has reexamined the need for the limitation assigned to technical reports written for this Command. Request the limited distribution statement for the enclosed accession numbers be changed to "Approved for public release; distribution unlimited." These reports should be released to the National Technical Information Service.

2. Point of contact for this request is Ms. Kristin Morrow at DSN 343-7327 or by e-mail at Kristin.Morrow@det.amedd.army.mil.

FOR THE COMMANDER:

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